

# ALBERTA OIL SANDS INDUSTRY

## QUARTERLY UPDATE

SUMMER 2014

Reporting on the period: Mar. 18, 2014 to June 15, 2014



# All about the oil sands

Background of an important global resource

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Canada has the third-largest oil reserves in the world, after Saudi Arabia and Venezuela. Of Canada's 173 billion barrels of oil reserves, 170 billion barrels are located in Alberta, and about 168 billion barrels are recoverable from bitumen. This is a resource that has been developed for decades but is now gaining increased global attention as conventional supplies—so-called "easy" oil—continue to be depleted. The figure of 168 billion barrels of bitumen represents what is considered economically recoverable with today's technology, but with new technologies, this reserve estimate could be significantly increased. In fact, total oil sands reserves in place are estimated at 1.8 trillion barrels.

There are three major bitumen (or oil sands) deposits in Alberta. The largest is the Athabasca deposit, which is located in the province's northeast in the Regional Municipality of Wood Buffalo. The main population centre of the Athabasca deposit is Fort McMurray. The second-largest oil sands deposit is referred to as Cold Lake, just south of Athabasca, with the main population centre the City of Cold Lake. The smallest oil sands deposit is known as Peace River, which is located in northwest-central Alberta. A fourth deposit called Wabasca links to the Athabasca and is generally lumped in with that area.

The existence of bitumen in Alberta has been known for a long time. The first mention of it in Canadian history was in 1719, when a Cree named Wapasu brought a sample of the "gum" to a Hudson's Bay trading post. First Nations in what is now the Wood Buffalo area had traditionally used the bitumen, which seeps from outcrops along the Athabasca River, to waterproof their canoes.

For the first time in 2012, in situ oil sands production exceeded mined oil sands production in Alberta. In 2013, 53 per cent of the province's oil sands volumes were produced using in situ

methods. Alberta will continue to rely to a greater extent on in situ production in the future, as 80 per cent of the province's proven bitumen reserves are too deep underground to recover using mining methods.

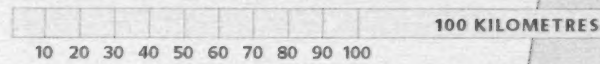
There are essentially two commercial methods of in situ (Latin for "in place," essentially meaning wells are used rather than trucks and shovels). In cyclic steam stimulation (CSS), high-pressure steam is injected into directional wells drilled from pads for a period of time, then the steam is left to soak in the reservoir for a period, melting the bitumen, and then the same wells are switched into production mode, bringing the bitumen to the surface.

In steam assisted gravity drainage (SAGD), parallel horizontal well pairs are drilled from well pads at the surface. One is drilled near the top of the target reservoir, while the other is drilled near its bottom. Steam is injected into the top well, a steam chamber forms, and the melted bitumen flows into the lower well via gravity and is pumped to the surface using artificial lift.

Both SAGD and CSS are used in the Cold Lake and Peace River deposits, while SAGD is the in situ technology of choice in the Athabasca deposit. The selection is based on a number of factors, including geology. The technologies combined currently produce just over one million barrels per day.

Research is underway on a number of other production technologies designed to optimize production, including variations on solvent-assisted SAGD and CSS, recovery using electricity and in situ combustion.

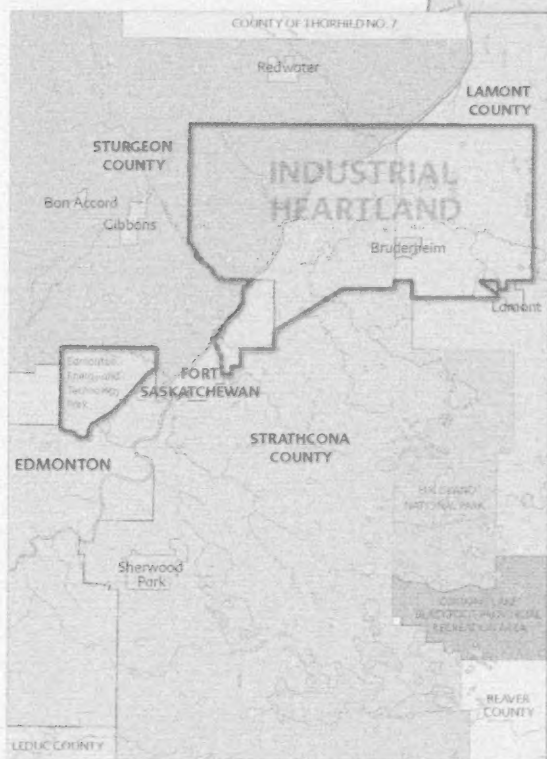
Bitumen that has not been processed, or "upgraded," can be used directly as asphalt. It must be diluted to travel by pipeline. Adding value, some producers upgrade their product into synthetic crude oil, which is a refinery feedstock. That can be transformed into transportation fuels and other products. ■



# Mapping the oil sands

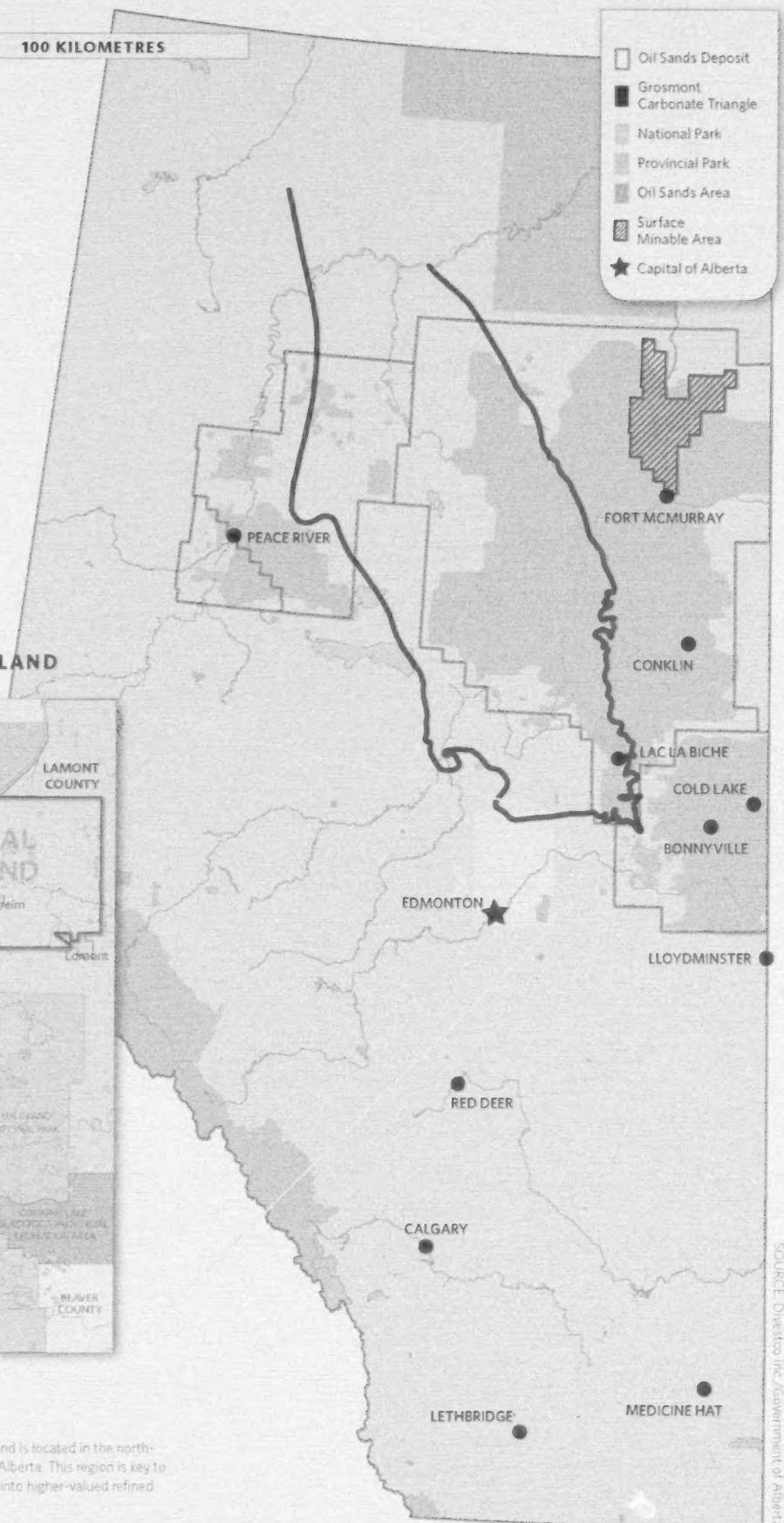
Canada's oil sands resources are often referred to as "the oil that technology made." Without intensive production technology development, the industry would not exist as it does today. These technologies still continue to be advanced and optimized, improving recovery and reducing environmental impacts.

## ALBERTA'S INDUSTRIAL HEARTLAND



Alberta's Industrial Heartland is over 143,815 acres in size, and is located in the north-eastern quadrant of the greater Edmonton region in central Alberta. This region is key to the value-added processing of Alberta's oil sands resources into higher-valued refined petroleum products and petrochemicals.

- Oil Sands Deposit
- Grosmont Carbonate Triangle
- National Park
- Provincial Park
- Oil Sands Area
- Surface Mineable Area
- Capital of Alberta





# GOVERNMENT UPDATE



## PREMIER HANCOCK RESPONDS TO FEDERAL NORTHERN GATEWAY PIPELINE DECISION

Premier Dave Hancock issued the following statement regarding the Government of Canada's decision to approve Enbridge Inc.'s proposed Northern Gateway Pipeline from Alberta to the coast of British Columbia.

"The decision by the federal government to accept the National Energy Board's recommendations on Enbridge's Northern Gateway Pipeline proposal is a step forward in accessing new markets for Canada's energy resources.

"New markets for our products will create and support more jobs, and generate increased revenue to help pay for vital public services like quality health care and education for all Canadians.

"Alberta will continue to support all safe and viable options to diversify and expand market access for Canada's resources. This includes increasing current pipeline capacity, developing new pipelines and moving product by rail. Getting product to market is vital to addressing the increased demand as well as a key factor in our country's economic prosperity.

"Every Canadian, no matter what province they reside in, expects that energy development is done with high standards of environmental protection. Our government continues to take action to meet that expectation by ensuring Alberta's resources are developed in a transparent, regulated and environmentally responsible manner.

"We recognize there is still much work to be done with the Northern Gateway project, and we look forward to the opportunities it presents for all Canadians."

## FAST PACE ON HIGHWAY 63 TWINNING CONTINUES

Progress continues on twinning Highway 63 to improve safety for motorists. More than 20 per cent of the 240 kilometres of twinning is already complete and open to the public, while more than 60 per cent of the project is under construction.

Albertans can look forward to future milestones.

By fall of 2015, 70 per cent of the twinning commitment is expected to be complete, and the remaining 30 per cent will be completed by fall 2016.

Budget 2014 invests \$423 million in Highway 63 improvements this fiscal year alone.

"Budget 2014 puts us in a solid position to stay on this aggressive construction schedule, keeping our promise to people in Fort McMurray and across Alberta. By this summer, all the contracts will have been awarded, and we expect

about 650 workers and 470 pieces of equipment to be out in full force," says Wayne Drysdale, minister of transportation.

A \$423-million investment in 2014-15 more than doubles last year's investment. In the last five months alone, \$250 million in Highway 63 twinning contracts have been awarded.

The accelerated twinning of Highway 63 is part of the Alberta government's commitment to building Alberta's economic future and providing a transportation network that helps move goods across Alberta to local, national or international markets.

The Alberta government has invested more than \$1.4 billion toward various Highway 63 and Highway 881 projects since 2005, providing critical infrastructure for the Athabasca oil sands region. In addition, more than \$530 million in municipal grant funding has been allocated in the last eight years to support numerous local priorities.

## BUDGET 2014 ADVANCES ALBERTA'S CARBON CAPTURE PROJECTS

The Government of Alberta's ongoing investment in carbon capture and storage (CCS) demonstrates our commitment to environmental stewardship and innovative solutions to reduce greenhouse gas emissions.

As part of Budget 2014, Alberta continues to invest in two CCS projects that will reduce greenhouse gas emissions from oil sands upgrading.

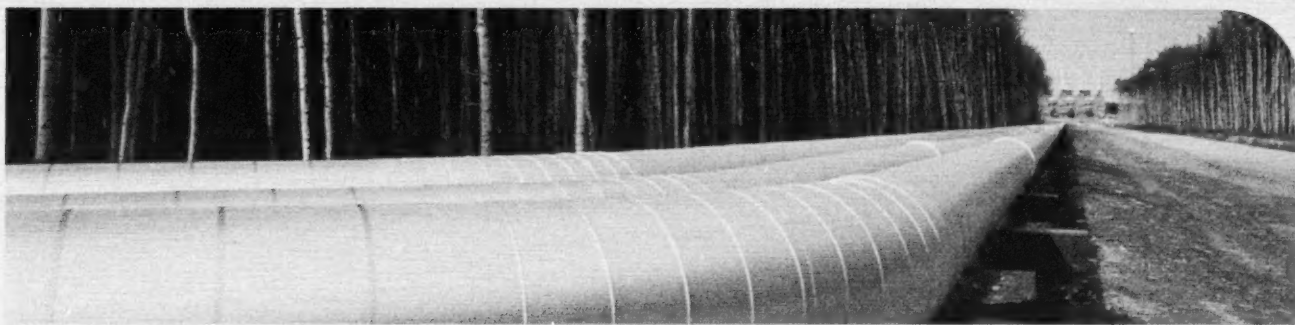
Minister of Energy Diana McQueen saw the significant progress being made on large-scale carbon capture units under construction as part of the Quest CCS project at the Scotford Upgrader during a visit to the site in April. The units will be used to capture CO<sub>2</sub> from upgrading and then transport it by a 65-kilometre underground pipeline to three injection wells north of the upgrader. There it will be safely and permanently stored more than two kilometres underground.

"The Alberta government is committed to carbon capture projects. With them, we are showing the world we take the responsible development of our resources seriously and we're becoming a world leader in CCS technology," McQueen says.

The Quest project will be the first commercial-scale CCS project in the world for an oil sands operation.

In Budget 2014, the Alberta government is investing \$144 million in CCS projects.

Alberta will invest almost \$1.3 billion over 15 years in two large-scale, oil sands-related CCS projects—the Alberta Carbon Trunk Line and Quest. This is an unparalleled investment in CCS for a jurisdiction of Alberta's size.



These projects will start up in 2015 and will store 2.76 million tonnes of CO<sub>2</sub> per year. This is the equivalent of taking 550,000 cars off the road each year.

#### **PREMIER HANCOCK STATEMENT ON THE NEW KEYSTONE XL DELAY**

The U.S. Department of State announced in April that it would delay its long-awaited decision on construction of the Keystone XL Pipeline until it has a better understanding of the expected outcome of legal challenges to the pipeline's route through Nebraska. Premier Dave Hancock issued the following statement in response:

"I am disappointed in today's announcement of yet another delay in the regulatory approval process for the Keystone XL Pipeline. Thorough, predictable and independent regulatory processes are in the interests of all participants.

"Keystone XL has been rigorously studied. We believe the project is in North America's best interest as it provides energy security, jobs and a dependable energy source from an environmentally responsible and democratic friend and ally.

"Our government has been clear that opening markets is our number one economic priority because more markets mean more long-term opportunities for all Canadians.

"Alberta's commitment to responsible environmental management strongly positions us as the safest and most secure energy supplier to our American neighbours."

#### **ALBERTA WELCOMES FEDERAL COMMITMENT TO ACTION ON RAIL SAFETY**

Alberta Minister of Transportation Wayne Drysdale issued the following statement in response to the federal government's [April 2014 announcement](#) to improve rail safety in Canada:

"We welcome the federal government's commitment to specific actions to increase safety in the movement of dangerous goods by rail across Canada. The announcement provides Albertans and all Canadians with assurance that dangerous goods are being moved safely through their communities.

"We will work with the federal government and industry to determine the best way to address these recommendations about railcar standards and speed, route planning and emergency response plans as they relate to short-haul lines under provincial jurisdiction.

"Alberta has already taken quick action and implemented previous Transportation Safety Board recommendations from

the Lac-Mégantic investigation for railways under provincial jurisdiction. Those recommendations addressed uncontrolled movements by unattended locomotives and tanker cars carrying dangerous goods.

"Alberta Transportation officials conduct compliance reviews of industrial railway facilities and inspect railway tracks, locomotives and automated railway crossings. They also provide training and information sessions for industry, municipalities and other key stakeholders."

Most railways in Alberta operate under federal jurisdiction. Alberta Transportation regulates industrial spur lines used to load and unload railcars off of mainlines, rail lines operated by historical parks, and two short-haul public railways operated solely within Alberta to transport goods or passengers.

#### **ALBERTA PREMIER RESPONDS TO FEDERAL GOVERNMENT ANNOUNCEMENT ON PIPELINE SAFETY SYSTEM**

Premier Dave Hancock issued the following statement on new measures [announced in May by the federal government](#) to further enhance Canada's pipeline safety system:

"Alberta is committed to continuous improvement to the pipeline safety system, and we applaud today's announcement by the Government of Canada to improve pipeline safety across the country. Pipelines are a safe, efficient and reliable way for Canada to move its oil and gas products, and are critical to accessing key global markets for Canada's energy products.

"Our government is committed to opening new markets for our energy resources in a safe and sustainable manner.

"These actions build on the principles of prevention, liability and preparedness, and also recognize that meaningful aboriginal participation in pipeline safety discussions is imperative. The future of our energy industry rests with our reputation to act on initiatives that protect our environment and consider the important role of aboriginal participation.

"Every Canadian, no matter what province or territory they call home, expects that energy development is done with a high degree of environmental safeguards, and the Province of Alberta supports initiatives like those announced today that strengthen the responsible development of energy resources." ■

# LABOUR UPDATE



## EMPLOYMENT AND SOCIAL DEVELOPMENT CANADA ANNOUNCES FUNDING INITIATIVE

The petroleum industry is facing significant human resource (HR) challenges. An aging workforce, rapid technological innovation, and increased competition for talent and growth are creating labour and skill shortages. The petroleum industry will need strategic solutions to address the challenge.

The Petroleum Human Resources Council helps the industry develop a sustainable, skilled and productive oil and gas workforce. We accomplish this by providing expert knowledge on petroleum labour market trends, occupational information and tools, and strategic HR intelligence and solutions for the industry, government and educators.

The council is pleased to announce that it has secured \$2.8 million in funding from Employment and Social Development Canada (ESDC) under the newly formed Sectoral Initiatives Program (SIP).

The SIP funds partnership-based projects that are national in scope or nationally significant, that support the development of labour market information, national occupational standards and certification/accreditation regimes, and that address skills shortages in strategic sectors of Canada's economy. ESDC was previously known as the Department of Human Resources and Skills Development Canada and was rebranded this year under a new name.

Funding of the three-year project allows the council to further develop its labour market information service to the industry and expand the occupational information and tools found on the Careers in Oil + Gas website. The council understands the need to continue to attract people to our industry, and up-to-date occupational information and tools will increase mobility and skills transferability of the labour force as well as build energy and career literacy across industry sectors and Canada.

The council's first project initiative is to continue producing annual labour market outlooks and quarterly human resources trends and insights reports with a focus on areas of oil and gas activity and key emerging sectors, such as the oil sands in Alberta, liquefied natural gas activity in British Columbia and the Bakken oil field movement in Saskatchewan and Manitoba. The council's labour market information provides key stakeholders, such as industry employers across Canada, with information to help with their workforce planning.

Aside from funding provided by the Government of Canada, the Petroleum Human Resources Council will

partner with multiple stakeholders, including provincial governments and the industry, to ensure development and delivery of timely, relevant and credible labour market information on Canada's oil and gas industry.

## GOVERNMENT OF CANADA ANNOUNCES A COMPREHENSIVE OVERHAUL OF THE TEMPORARY FOREIGN WORKER PROGRAM

The Government of Canada wants to ensure that the Temporary Foreign Worker Program (TFWP) is only used as intended, as a last and limited resort to fill acute labour shortages on a temporary basis when qualified Canadians are not available.

The reforms to the TFWP include:

1. Limiting access to the TFWP to ensure Canadians are first in line for available jobs
2. More and better labour market information for stronger screening
3. Stronger enforcement and tougher penalties

Read the full [Government of Canada announcement](#) for further details on the TFWP reforms.

## 2013 ALBERTA WAGE AND SALARY SURVEY

The recently released 2013 Alberta wage and salary survey provides information on wages and salaries for full-time and part-time employees in Alberta by occupation, geographic area and industry group. This information can help you make informed compensation decisions and assist in developing competitive hiring policies.

## UNITED STATES RECRUITING FACT SHEET

Are you recruiting internationally but have no idea where to start? The United States recruiting fact sheet provides information on the labour supply, migration trends and credential recognition, along with recruitment tips, to help you make informed recruitment decisions.

## NEW LABOUR MARKET INFORMATION

The Alberta government recently released updated versions of both the Alberta Short-Term Employment Forecast and Alberta's Occupational Demand and Supply Outlook. These resources can help you make decisions about future staffing programs and resources on a per-occupation basis.

## CONTACT US

Contact us with questions or concerns or for more information at [ABWorkforceinfo@gov.ab.ca](mailto:ABWorkforceinfo@gov.ab.ca). ■



## What's new in the oil sands BUSINESS



■ Syncrude Canada Ltd. says it has passed the \$2-billion milestone of spend with aboriginal businesses. The joint venture, which currently produces about 315,000 barrels per day of synthetic crude oil from its northern Alberta oil sands mine, says it does business with about 25 aboriginal-owned businesses in the Regional Municipality of Wood Buffalo. It is a founding member of the Northeastern Alberta Aboriginal Business Association.

Syncrude started tracking its spend with aboriginal-owned businesses in 1992, and hit the \$1-billion mark in 2006.

■ The proposed \$11-billion Joslyn North Mine has been shelved while its owners find ways to reduce costs, the project's operator, Total E&P Canada Ltd., announced in late May.

The company will be laying off about 150 Calgary-based staff who had been working on the project.

Total is operator of the Joslyn project with a 38.25 per cent interest while Suncor Energy Inc. has 36.75 per cent interest, Occidental Petroleum Corporation has 15 per cent and INPEX CORPORATION has 10 per cent.

■ Two new steam assisted gravity drainage (SAGD) projects achieved first oil in early 2014. In the Cold Lake region, Baytex Energy Corp. achieved first oil at the Gemini SAGD project in March, according to the Alberta Energy Regulator. In the southern Athabasca region, Grizzly Oil Sands ULC marked first oil at the Algar Lake SAGD project in the first quarter, according to Gulfport Energy Corporation, which holds a 24.9 per cent interest in the company.

In addition, Grizzly's Windell rail transloading facility at Conklin, Alta., commenced operations during the first quarter of 2014 and the first load of dilbit from Algar Lake was hauled by truck to the Windell terminal for sales to the U.S. Gulf Coast market, Gulfport says. Capacity at Algar Lake is 5,000 barrels per day.

At Gemini, which Baytex purchased from Koch Exploration Canada Corporation in 2012 for \$120 million, capacity is 1,200 barrels per day.

■ Suncor Energy Inc. says that bitumen volumes from its Firebag SAGD project are now being processed at refineries on the U.S. Gulf Coast. Earlier in 2014, Suncor began shipments of heavy crude on the Keystone South Pipeline, providing the company with more than 50,000 barrels per day of heavy crude shipping capacity to the region, which it calls a profitable outlet for the growing bitumen production at Firebag.

■ MEG Energy Corp. is now moving oil sands crude on unit trains. Concurrent with the fourth-quarter ramp-up of production at the company's Christina Lake SAGD project, MEG commissioned its proprietary 900,000-barrel Stonetell storage terminal and completed its proprietary pipeline connection to Canexus Corporation's rail loading facility at Bruderheim, Alta., establishing the first direct wellhead to rail pipeline connection in the Canadian oil industry.

The first unit train of MEG product was loaded in December with additional unit trains loaded in January.

■ Canadian Natural Resources Limited's new Kirby South SAGD project is well on its way to ramp up to full capacity of 40,000 barrels per day by year's end.

Canadian Natural says Kirby South was delivered ahead of schedule last summer at a cost of \$1.26 billion. Steam injection began last September, and June production averaged close to 18,000 barrels per day.

■ Partners in Syncrude Canada Ltd. are reducing the projected capital cost of the Mildred Lake mine train replacement by \$300 million. Canadian Oil Sands Limited says the cut is thanks to the absence of unplanned events during project execution along with better estimates going into it.

The project, which involves the two existing mine trains being dismantled and new mine trains being constructed at a new location, is now expected to cost \$3.9 billion versus the previous estimate of \$4.2 billion. The new mine trains are expected to be operational in the fourth quarter of 2014. ■

## What's new in the oil sands

# TECHNOLOGY



■ GE reports that MEG Energy Corp. has selected its modularized evaporation technology to recycle a significant portion of once-through steam generator (OTSG) blowdown at Phases 2B and 3A of the Christina Lake steam assisted gravity drainage (SAGD) project. The system will enable blowdown to be reused as boiler feedwater as opposed to disposing of it by deep well injection.

"We've witnessed industry trends of SAGD projects either installing new systems with OTSG evaporators or retrofitting existing units," says Bill Heins, general manager, thermal systems—water and process technologies for GE Power & Water. Heins says that as thermal oilsands projects proliferate, more companies are turning to these systems to address the critical issue of how to handle produced water.

■ Statoil Canada Ltd. says it will test and deploy 14 new technologies over the next five to 10 years to create a step-change in its SAGD performance. The goal is to reduce the amount of energy and water used to produce bitumen while improving overall bitumen recovery and sustainability.

"The technologies were selected following two years of extensive analysis and model simulations to identify opportunities for Statoil's next proposed oil sands development, the Corner Project, as well as a major expansion of our Leismer Demonstration Project," Statoil says in its 2013 *Oil Sands Report*.

At Corner, if the technologies are successful, Statoil expects to achieve a 10-15 per cent reduction in steam to oil ratio (SOR). Similar SOR reductions are expected if the technologies are incorporated at Leismer, which produced about 14,000 barrels per day in 2013 with an SOR of 3.2:1.

The technologies include:

- Systems to increase the percentage of steam produced beyond 80 per cent with a goal of reaching 90 per cent, resulting in reduced water and energy use.
- Infill drilling, which has been successfully implemented at other SAGD sites but not yet at Statoil's operations.
- Solvent co-injection, which Statoil started piloting at Leismer in late 2013, a technology also being tested by several other in situ producers.

- Control devices installed on steam injection wells to more evenly distribute steam and on producing wells to increase recovery.

■ Laricina Energy Ltd.'s Saleski pilot project was among the winners at the 24th annual Summit Awards Gala. The event—held by the Association of Professional Engineers and Geoscientists of Alberta—recognizes leadership and project excellence in the engineering and geoscience community. Saleski was honoured with the Project Achievement Award for demonstrating engineering and geoscience skills and contributing to technical progress and the betterment of society.

Saleski is the first in situ horizontal well heavy-oil project in the Grosmont carbonate formation.

■ Cenovus Energy Inc. says initiatives to improve the steam to oil ratio (SOR) at its Foster Creek SAGD project are working.

The SOR had trended higher than expected in 2013 due primarily to the age-related formation of a common steam chamber, so Cenovus has been using new operating techniques to improve the conformance of steam along wellbores.

The company says initiatives include optimal placement of steam across its well pads, timely placement of older pads on blowdown and transferring steam to new pads at the most appropriate time.

"We have increased our implementation to better monitor our steam movement and coalescence of the steam chambers," says John Brannan, executive vice-president and chief operating officer. "We are currently running at 95 per cent with our downhole instrumentation, and we plan to maintain this level going forward."

■ Aquatech International has been awarded a contract to provide its evaporator technology for Japan Canada Oil Sands Limited's Hangingstone SAGD expansion project.

The company's vertical-tube falling film evaporator technology will be used to treat and recover over 95 per cent of once-through steam generator blowdown to supply as boiler feedwater make-up. ■



## OIL SANDS PROJECT TECHNOLOGY GUIDE

### CSS—CYCLIC STEAM STIMULATION

CSS involves injecting high-pressure steam into the reservoir for several weeks, followed by several weeks where the reservoir is left to "soak." The heat softens the bitumen and the water dilutes and separates the bitumen from the sand. The pressure creates cracks and openings through which the bitumen can flow back into the steam injector wells, which are converted to production mode.

### ET-DSP—ELECTRO-THERMAL DYNAMIC STRIPPING (EMERGING)

Electrodes are placed in a grid configuration and a production well is located within the centre of each series of electrode wells.

### PRIMARY PRODUCTION—COLD HEAVY OIL PRODUCTION WITH SAND

Cold heavy oil production with sand (CHOPS) is a non-thermal in situ primary production technology that involves the continuous production of sand using progressing cavity pumps to enhance recovery.

### SAGD—STEAM ASSISTED GRAVITY DRAINAGE

SAGD employs two parallel horizontal wells: one injection well near the top of the reservoir, through which high-pressure steam is continuously injected, and one production well near the bottom of the reservoir into which the softened bitumen continuously flows and can be pumped to the surface. SAGD surface facilities include steam generation, water processing and bitumen treatment.

### SOLVENT INJECTION/CO-INJECTION

Solvent injection or co-injection with steam is seen as one of the most promising incremental enhancements to the steam assisted gravity drainage (SAGD) process. In solvent co-injection, it is projected that hot vapour solvents carried by steam can penetrate deeper into the warm bitumen zone than steam alone. This results in a thicker mobilization layer and a larger bitumen flow along the SAGD chamber wall and increased production with lower greenhouse gas emissions. Solvent injection/co-injection technologies include bitumen extraction solvent technology (BEST), solvent aided process (SAP) and solvent-cyclic SAGD (SC-SAGD).

### SURFACE MINING

Trucks take oil sand to crushers where it is prepared for extraction. Crushed oil sand is mixed with warm water and fed through a hydro-transport system to an extraction plant where the mixture of oil, sand and water is placed in separation vessels. Injected air forms tiny bubbles that separate bitumen from the sand and floats it to the tank surface where it forms a thick froth that is skimmed off, mixed with naphtha and spun in a centrifuge to remove the remaining solids, water and dissolved salts. The cleaned sand and the water are then sent to the tailings area where the water is recycled back to the extraction process.

### TAGD—THERMAL ASSISTED GRAVITY DRAINAGE (EMERGING)

TAGD is a process being developed for the in situ recovery of bitumen from carbonate formations. TAGD uses an array of downhole heaters installed in horizontal wells to heat the reservoir via thermal conduction.

### THAI—TOE TO HEEL AIR INJECTION (EMERGING)

THAI uses a vertical air injection well with a horizontal production well. Rather than steam, THAI technology injects air and then relies on underground combustion of a portion of the oil in the ground to generate the heat required to melt the remainder of the bitumen and allow it to flow into the production well. The process is intended to reduce greenhouse gas emissions and water use.

### UPGRADING

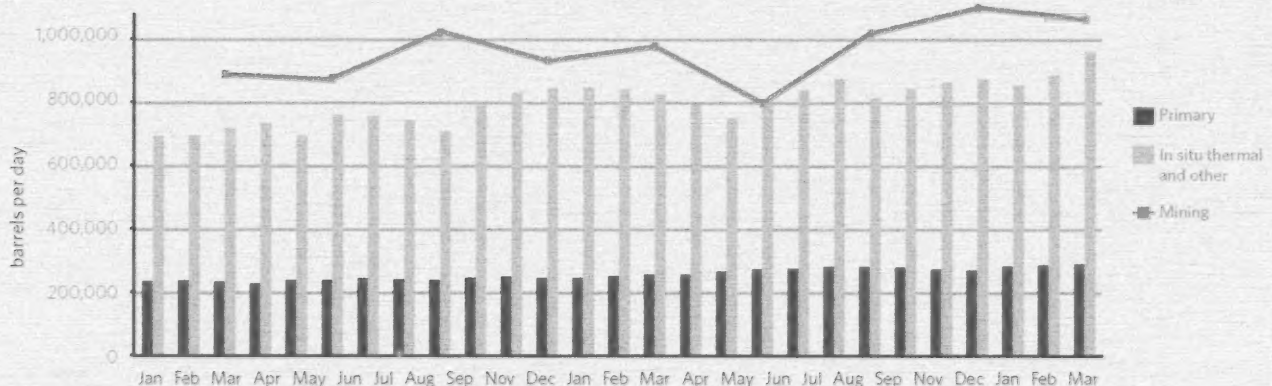
Once bitumen is produced, it is sent for further upgrading, a process that breaks down the heavy carbon molecules and converts it into a product similar to conventional crude oil. This can be processed by refiners into value-added products.

### VSD—VERTICAL STEAM DRIVE

Vertical steam drive incorporates the creation of hexagonal well patterns. At Carmon Creek, Shell plans to drill six vertical production wells in a hexagonal pattern, with one dedicated steam injector well in the centre. The goal of this recovery method is to drive fluid horizontally from the steam injector well to the producer wells, without relying on gravity or vertical flow, and to operate at low pressures.

SOURCE: Climate Change and Emissions Management Corporation/Oil Sands Developers Group/Oil Sands Review

Alberta Oil Sands Production by Extraction Method



SOURCE: Alberta Energy Regulator

# Project listings

Updated status of oil sands projects in Alberta As of June 2014

CURRENT PROJECT	CAPACITY	START-UP	REGULATORY STATUS	TECHNOLOGY
<b>NORTH ATHABASCA REGION — MINING</b>				
<b>CANADIAN NATURAL RESOURCES LIMITED</b>				
<b>Horizon</b>				
During the first quarter of 2014, Horizon continued to achieve strong and reliable operating performance, with 500 production averaging approximately 113,000 barrels per day, a four per cent increase from 2013 first-quarter levels and a one per cent increase over 2013 fourth-quarter levels. Production is targeted to increase in 2014 by about 11,000 barrels per day from 2013 levels as a result of the continued focus on effective and efficient operations. The overall Horizon Phase 2/3 expansion is 37 per cent physically complete.				
Phase 1	135,000	2008	Operating	Mining
Reliability - Tranche 2	5,000	2014	Operating	Mining
Phase 2A	12,000	2015	Operating	Mining
Phase 2B	45,000	2016	Operating	Mining
Phase 3	80,000	2017	Operating	Mining
<b>IMPERIAL OIL LIMITED</b>				
<b>Keen</b>				
Imperial Oil says that Keen gross bitumen production continues to ramp up. Production was impacted during the fourth quarter by harsh winter weather and equipment reliability issues that are being addressed. Production rates of 100,000 barrels per day have been reached, and ongoing activities to stabilize performance at these higher levels are progressing. The Keen expansion project was 72 per cent complete at year end and remains on target for a 2015 start-up.				
Phase 1	180,000	2013	Operating	Mining
Phase 2	10,000	2015	Operating	Mining
Phase 3	80,000	2020	Operating	Mining
Phase 4 Debotleneck	45,000	TBD	Operating	Mining
<b>SHELL ALBIAN SANDS</b>				
<b>Jackpine</b>				
Phase 1A	100,000	2010	Operating	Mining
Phase 1B	100,000	TBD	Operating	Mining
Expansion	100,000	2017	Operating	Mining
<b>Muskeg River</b>				
Minority partner, Marathon Oil Corporation says its income from the project increased in the first quarter of 2014 primarily as a result of lower contract services and contract labour and higher turnaround costs in the same quarter of 2013. The impact of higher price realizations in the first quarter of 2014 was mostly offset by lower net sales volumes due to reliability issues at both the Jackpine and Muskeg River mines.				
Commercial	155,000	2002	Operating	Mining
Expansion & Debotlenecking	115,000	TBD	Operating	Mining
<b>Pierre River</b>				
Shell has informed regulators that it is indefinitely halting work on the Pierre River project. The company has asked that the regulatory approval process be suspended.				
Phase 1	100,000	TBD	Operating	Mining
Phase 2	100,000	TBD	Operating	Mining
<b>SUNCOR ENERGY INC.</b>				
<b>Base Operations</b>				
Suncor says that it reached a synthetic crude oil production record of 312,200 barrels per day in the first quarter of 2014, which included a 21 per cent increase in sweet production compared to the prior-year quarter due to improved upgrader reliability.				
Millennium Mine	294,000	1997	Operating	Mining
Steepbank Debotleneck Phase 3	4,000	2007	Operating	Mining
Millennium Debotlenecking	23,000	2008	Operating	Mining
North Steepbank Extension	180,000	2012	Operating	Mining
<b>Fort Hills</b>				
Suncor says that Fort Hills project activities are currently focused on detailed engineering, procurement and the ramp-up of field construction.				
Phase 1	160,000	2017	Operating	Mining
Debotleneck	20,000	TBD	Operating	Mining
<b>Voyageur South</b>				
Suncor considers Voyageur South to be a "longer-term" project and has not confirmed a start-up date.				
Phase 1	120,000	TBD	Operating	Mining
<b>SYNCRUDE CANADA LTD.</b>				
<b>Mildred Lake/Aurora</b>				
Canadian Oil Sands Limited says that the cost estimate for the Mildred Lake Mine Replacement project has been reduced to \$3.9 billion from \$4.2 billion, and the project remains on schedule for completion in the fourth quarter of this year.				
Base Mine Stage 1 & 2 Expansion	200,700	1978	Operating	Mining
Stage 3 Expansion	116,300	2006	Operating	Mining
Centrifuge Tailings Management	TBD	TBD	Operating	Mining

CURRENT PROJECT	CAPACITY	START-UP	REGULATORY STATUS	TECHNOLOGY
<b>Mildred Lake/Aurora (continued)</b>				
Aurora South Train 1	100,000	2016	Operating	Mining
Aurora South Train 2	100,000	2016	Operating	Mining
Mildred Lake Mine Extension (MLK)	TBD	2023	Operating	Mining
<b>TECK RESOURCES LIMITED</b>				
<b>Frontier</b>				
Teck says that the cumulative federal review period is estimated to be approximately two years, making 2015 the earliest an approval decision and receipt of required permits is expected. An exploration program was completed at Frontier in the winter of 2014 to provide additional data to support the regulatory review process and ongoing engineering work.				
Phase 1	74,600	2021	Operating	Mining
Phase 2	84,000	2024	Operating	Mining
Phase 3	79,300	2027	Operating	Mining
Phase 4 Equinox	56,400	2030	Operating	Mining
<b>TOTAL E&amp;P CANADA LTD.</b>				
<b>Joslyn North Mine</b>				
Total has announced it will delay the Joslyn mine while project partners look ways to reduce costs.				
Phase 1	100,000	2019	Operating	Mining
<b>NORTH ATHABASCA REGION — IN SITU</b>				
<b>ATHABASCA OIL CORPORATION</b>				
<b>Birch</b>				
Athabasca will be reducing its workforce by 15 per cent. The layoffs, focused primarily in its Calgary office, will largely affect employees directly or indirectly tied to projects that are not being funded in the near term.				
Phase 1	12,000	TBD	Operating	SAGD
<b>Dover West Carbonates (Leduc)</b>				
A fourth production cycle for the TAGO pilot test is scheduled for the fourth quarter of 2013. Athabasca had been encouraged by results so far.				
Phase 1 Demonstration	6,000	2016	Operating	SAGD
Phase 2 Demonstration	6,000	TBD	Operating	SAGD
<b>Dover West Sands &amp; Cretaceous</b>				
Athabasca Oil is currently awaiting regulatory approval for the Dover West Sands Phase 1.				
Phase 1	12,000	2016	Operating	SAGD
Phase 2	35,000	2019	Operating	SAGD
Phase 3	35,000	2020	Operating	SAGD
Phase 4	36,000	2022	Operating	SAGD
Phase 5	33,000	2024	Operating	SAGD
<b>BP PLC</b>				
<b>Terre de Grace</b>				
BP says that ongoing appraisal activities continue.				
Pilot	10,000	TBD	Operating	SAGD
<b>BIRCH ENERGY CORPORATION</b>				
<b>Dover</b>				
Athabasca Oil Corporation has exercised its option to divest its 40 per cent interest in the Dover Commercial Project to PetroChina's Phoenix Energy Holdings Limited for approximately \$1.23 billion. This transaction transfers ownership of the project to Phoenix subsidiary Birch Energy Corporation.				
Dover Experimental Pilot	2,000	2017	Operating	SAGD
Dover North Phase 1	50,000	2016	Operating	SAGD
Dover North Phase 2	50,000	2018	Operating	SAGD
Dover South Phase 3	50,000	2021	Operating	SAGD
Dover South Phase 4	50,000	2023	Operating	SAGD
Dover South Phase 5	50,000	2025	Operating	SAGD
<b>MacKay River</b>				
Birch says that the module fabrication program is underway for the central processing facility, with some of the largest pieces of equipment arriving at site for assembly. Modules are nearing completion across Alberta and the United States. The structural steel and pipe for the project has been shipped from Texas and China, and many of the concrete foundations have already been poured. Well pads and pipelines are under construction; the pipe road closings are nearly complete and the infield right-of-way has been plied. Birch is planning to hydro test much of the infield pipelines this summer.				
Phase 1	35,000	2015	Operating	SAGD
Phase 2	40,000	2018	Operating	SAGD
Phase 3	40,000	2020	Operating	SAGD
Phase 4	35,000	2022	Operating	SAGD
<b>CANADIAN NATURAL RESOURCES LIMITED</b>				
<b>Birch Mountain</b>				
Canadian Natural says Birch is in the planning stages.				

CURRENT PROJECT	CAPACITY	START-UP	REGULATORY STATUS	TECHNOLOGY
<b>Birch Mountain (Continued)</b>				
Phase 1	60,000	2019	Approved	SAGD
Phase 2	60,000	2023	Approved	SAGD
<b>CENOVUS ENERGY INC.</b>				
<b>East McMurray</b>				
Cenovus says this project remains part of its portfolio of long-term development opportunities.				
Phase 1	30,000	TBD	Approved	SAGD
<b>Starbank</b>				
Cenovus says this project remains part of its portfolio of long-term development opportunities.				
Phase 1	30,000	TBD	Approved	SAGD
<b>Telephone Lake</b>				
Cenovus says a dewatering pilot project designed to remove an underground layer of non-potable water sitting on top of the oil sands deposit was successfully concluded during the fourth quarter of 2013. Approximately 30 per cent of the top water was removed during the pilot and replaced with compressed air. Regulatory approval for the Telephone Lake project is anticipated in the second quarter of 2014.				
Phase A	45,000	TBD	Approved	SAGD
Phase B	45,000	TBD	Approved	SAGD
<b>E-T ENERGY LTD.</b>				
<b>Poplar Creek</b>				
E-T Energy has engaged Sayer Energy Advisors to dispose of its oil sands leases and is refocusing both its time and capital on development of its technology.				
Experimental Plant	10,000	2013	Approved	ES-DSP
Phase 1	10,000	TBD	Approved	ES-DSP
Phase 2	40,000	TBD	Approved	ES-DSP
<b>GRIZZLY OIL SANDS LLC</b>				
<b>Thickwood</b>				
The Alberta Energy Regulator says it will defer decisions on applications for in situ oil sands projects in the new "shallow thermal area" of the Athabasca region until it has developed formal regulatory requirements. Grizzly Thickwood is one of five impacted projects.				
Phase 1	6,000	2017	Approved	ES-SAGD
Phase 2	6,000	TBD	Approved	ES-SAGD
<b>HUSKY ENERGY INC.</b>				
<b>Saski</b>				
Husky filed the regulatory application for its Saski pilot in early May 2013.				
Carbonate Pilot	3,000	2017	Approved	ES-SAGD
<b>Sunrise</b>				
Husky says Phase 1 remains on track for start-up in the second half of 2014. The hydrotesting of piping and the completion of electrical and instrumentation work in addition to the operations control centre is under way for plant 1A. All well pads, diluent, diluent hydrate and gathering pipelines are complete and progressing as planned through the commissioning phase. In the first quarter of 2014, an additional 35 square kilometres of 3-D seismic survey data was acquired and 12 stratigraphic wells were drilled to support continued field development.				
Phase 1A	60,000	2014	Approved	SAGD
Phase 2A	70,000	2018	Approved	SAGD
Phase 2B	70,000	2020	Approved	SAGD
<b>IMPERIAL OIL LIMITED</b>				
<b>Aspen</b>				
Alberta has issued the final terms of reference for Imperial's Aspen project.				
Phase 1	45,000	2020	Approved	SAGD
Phase 2	45,000	TBD	Approved	SAGD
Phase 3	45,000	TBD	Approved	SAGD
<b>IMPERIAL OIL LIMITED</b>				
<b>Tamarack</b>				
Imperial Energy says that it has suspended activity on the Tamarack project based on the uncertainty that there is no timeline defined by the Alberta Energy Regulator for a new regulatory framework for shallow SAGD projects, and that there is no clarity as to a path for approval for its Tamarack application. Until there is greater regulatory certainty as to a path to approval, Imperial will limit Tamarack spending to only essential items.				
Phase 1	20,000	2017	Approved	SAGD
<b>KOCH EXPLORATION CANADA CORPORATION</b>				
<b>Dunkirk</b>				
Alberta has issued the proposed terms of reference for Koch's Dunkirk SAGD project, one of the first steps in the regulatory process.				
Phase 1	30,000	2016	Approved	SAGD
Phase 2	30,000	TBD	Approved	SAGD
<b>MARATHON OIL CORPORATION</b>				
<b>Birchwood</b>				
Marathon filed its regulatory application in 2012. Regulatory approval and project sanctioning are expected in 2013.				
Demonstration	12,000	2017	Approved	SAGD
<b>OAK POINT ENERGY LTD.</b>				
<b>Lewis</b>				
The AER and Alberta Environment have approved Oak Point's Lewis project, which is estimated to cost \$6.5 billion.				
Pilot	1,720	TBD	Approved	SAGD

CURRENT PROJECT	CAPACITY	START-UP	REGULATORY STATUS	TECHNOLOGY
<b>PROSPER PETROLEUM LTD.</b>				
<b>Rigel</b>				
Prospere Petroleum filed its regulatory application for the Rigel SAGD project in November 2013.				
Phase 1	10,000	2015	Approved	SAGD
<b>SILVERWILLOW ENERGY CORPORATION</b>				
<b>Audet</b>				
SilverWillow says it continues to advance the Audet project through stakeholder engagement and meetings with the regulators. The company is still awaiting a more definitive description of new regulatory requirements that will apply to shallow SAGD projects announced earlier this year. Until the company has clarity on the new requirements it will limit spending on Audet to those activities required to advance the regulatory process.				
Pilot	12,000	2018	Approved	SAGD
<b>SOUTHERN PACIFIC RESOURCE CORP.</b>				
<b>STP-McKay</b>				
Southern Pacific continues to work with the series of inflow control devices (ICDs) that was installed at STP-McKay earlier this year and overall is pleased with ongoing performance. Southern Pacific plans to install additional ICD configurations; the program is currently being finalized. The next set of ICD installations has been delayed, primarily due to the strategic and financial alternatives review process.				
Phase 1	12,000	2013	Approved	SAGD
Phase 1 Expansion	6,000	2016	Approved	SAGD
Phase 2A	12,000	2018	Approved	SAGD
Phase 2B	6,000	2018	Approved	SAGD
<b>SUNCOR ENERGY INC.</b>				
<b>Dover</b>				
Dover says the oil is currently being circulated into the reservoir to open a path between the injection well and the producer well. Propane or butane injection on the solvent-only production pilot is expected to begin in the first quarter of 2014. Operations will continue until 2015.				
Demonstration Plant	500	2013	Approved	ES-S
<b>Firebag</b>				
Suncor says it has completed ramp-up of Firebag Stage 4. The company continues to advance further debottlenecking initiatives of logistics infrastructure and Firebag facilities.				
Stage 1	35,000	2004	Approved	SAGD
Stage 2	35,000	2006	Approved	SAGD
Co-generation and Expansion	25,000	2007	Approved	SAGD
Stage 3	42,500	2011	Approved	SAGD
Stage 4	42,500	2012	Approved	SAGD
Stage 5	62,500	2018	Approved	SAGD
Stage 6	62,500	2019	Approved	SAGD
Stage 3-6 Debottleneck	28,000	TBD	Approved	SAGD
<b>Lewis</b>				
After the MacKay River expansion and debottlenecking at both Firebag and MacKay River, Lewis is expected to be Suncor's next area of in situ development focus.				
Phase 1	40,000	TBD	Approved	ES-SAGD
Phase 2	40,000	TBD	Approved	ES-SAGD
<b>MacKay River</b>				
Suncor said in April it reached a milestone by achieving first steam on the well pads associated with the MacKay River facility debottleneck project, with first oil expected in the third quarter of 2014. Suncor also continues to work toward a 2014 sanction decision of the MacKay River expansion project.				
Phase 1	33,000	2007	Approved	SAGD
Debottleneck	5,000	TBD	Approved	SAGD
MR2	20,000	2017	Approved	SAGD
<b>SUNSHINE OIL SANDS LTD.</b>				
<b>Harper</b>				
Alberta's enactment of the Lower Athabasca Regional Plan in 2013 created new conservation areas that impacted the Harper project. Sunshine received compensation from the government in December 2013.				
Carbonate Pilot	1,000	TBD	Approved	ES-S
<b>Legend Lake</b>				
Sunshine says regulatory approval for the first 10,000-barrel-per-day phase is expected later in 2013. The company is completing final work for its environmental analysis, which will support work for significant commercial expansion.				
Phase A1	10,000	2016	Approved	SAGD
Phase A2	30,000	TBD	Approved	SAGD
Phase B1	30,000	TBD	Approved	SAGD
Phase B2	30,000	TBD	Approved	SAGD
<b>Thickwood</b>				
Alberta has issued the final terms of reference for Sunshine's Thickwood extension project.				
Phase A1	10,000	2015	Approved	SAGD
Phase A2	30,000	2017	Approved	SAGD
Phase B	30,000	2021	Approved	SAGD
<b>West Dils</b>				
Sunshine Oil Sands Ltd. says its priority for the second quarter of 2014 is to secure financing to restart construction of its first 100,000-barrel-per-day commercial SAGD project at West Dils. The company is examining financing alternatives with help from its financial advisers.				
Phase A1	5,000	2015	Approved	SAGD
Phase A2	5,000	TBD	Approved	SAGD
Phase A3	30,000	2018	Approved	SAGD
Phase B	20,000	2023	Approved	SAGD
Phase C1	80,000	TBD	Approved	SAGD
Phase C2	30,000	TBD	Approved	SAGD



CURRENT PROJECT	CAPACITY	START-UP	REGULATORY STATUS	TECHNOLOGY
<b>SOUTH ALBERTA REGION — IN SITU</b>				
<b>ALBERTA OIL SANDS INC.</b>				
<b>Hangingstone</b>				
Altaba says that all 25 producer and injector laterals have now been drilled in a program that delivered better than expected cost and schedule; reservoir quality is consistent with expected results. The project was 80 per cent complete at March 31, 2014, and approximately 90 per cent of total costs have now been contracted.				
Phase 1 Pilot	12,000	2015	Approved	SAGD
Phase 2	40,000	2017	Approved	SAGD
Phase 3	30,000	2018	Approved	SAGD
<b>BLACKPEARL RESOURCES INC.</b>				
<b>Blackrod</b>				
BlackPearl says that a second SAGD pilot well pair was converted to SAGD in March and is expected to reach peak production rates in 12-15 months. The company continues to expect approval of the 80,000-barrel-per-day commercial development application later in 2014.				
Pilot	800	2011	Approved	SAGD
Phase 1	20,000	2015	Approved	SAGD
Phase 2	30,000	2018	Approved	SAGD
Phase 3	30,000	2021	Approved	SAGD
<b>CANADIAN NATURAL RESOURCES LIMITED</b>				
<b>Gregoire Lake</b>				
Canadian Natural says Gregoire Lake is in the planning stages.				
Phase 1	60,000	TBD	Approved	SAGD
Phase 2	60,000	TBD	Approved	SAGD
<b>Grouse</b>				
Canadian Natural says Grouse is in the planning stages. First production is expected between 2017 and 2019.				
Commercial	50,000	2018	Approved	SAGD
<b>Kirby</b>				
Canadian Natural says the reservoir is responding as expected with first-quarter 2014 production averaging 5,000 barrels per day and April 2014 production averaging approximately 14,000 barrels per day. Production is targeted to grow to facility capacity of 40,000 barrels per day by year-end. The Kirby North project is continuing toward commencement of construction and regulatory approvals are progressing.				
K31 - Kirby South	40,000	2013	Approved	SAGD
K31 - Kirby North	40,000	2017	Approved	SAGD
K32 - Kirby North	60,000	2022	Approved	SAGD
<b>CAVALIER ENERGY INC.</b>				
<b>Hood</b>				
Cavalier owner Paramount Resources says the company anticipates that regulatory approvals for the initial 10,000-barrel-per-day phase of its Hood project will be received by mid-2014. Front-end engineering and design work was completed in 2013.				
Phase 1	10,000	2017	Approved	SAGD
Phase 2	35,000	TBD	Approved	SAGD
Phase 3	35,000	TBD	Approved	SAGD
<b>CENOVUS ENERGY INC.</b>				
<b>Christina Lake</b>				
Cenovus says the Phase F expansion is on schedule and on budget with about 97 per cent of the project complete and procurement, plant construction and engineering work continuing. Engineering work also continues for Phase G.				
Phase 1A	10,000	2002	Approved	SAGD
Phase 1B	8,800	2008	Approved	SAGD
Phase C	40,000	2011	Approved	SAGD
Phase D	40,000	2012	Approved	SAGD
Phase E	40,000	2013	Approved	SAGD
Optimization (Phases C, D, E)	72,000	2015	Approved	SAGD
Phase F	50,000	2016	Approved	SAGD
Phase G	50,000	2017	Approved	SAGD
Phase H	50,000	2019	Approved	SAGD
<b>Foster Creek</b>				
Cenovus says Phase F is on schedule and on budget with 93 per cent of the project complete and on track to start up, stream in the next month. Production is expected in the third quarter of 2014, with full ramp-up following 12 months after Phase G is 69 per cent complete, and Phase H is 42 per cent complete.				
Phase A	24,000	2001	Approved	SAGD
Phase B Debutenack	6,000	2003	Approved	SAGD
Phase C Stage 1	10,000	2005	Approved	SAGD
Phase C Stage 2	20,000	2007	Approved	SAGD
Phase D	30,000	2009	Approved	SAGD
Phase E	30,000	2009	Approved	SAGD
Phase F	45,000	2014	Approved	SAGD
Phase G	40,000	2015	Approved	SAGD
Phase H	40,000	2016	Approved	SAGD
Phase J	50,000	2019	Approved	SAGD
Future Optimization	15,000	TBD	Approved	SAGD
<b>Grand Rapids</b>				
Cenovus received regulatory approval for the Grand Rapids project in the first quarter. The company plans to move forward with Phase B, and continue its work on the SAGD pilot project, which has two producing well pairs.				
Pilot	600	2011	Approved	SAGD

CURRENT PROJECT	CAPACITY	START-UP	REGULATORY STATUS	TECHNOLOGY
<b>Grand Rapids (continued)</b>				
Phase A	60,000	2017	Approved	SAGD
Phase B	60,000	TBD	Approved	SAGD
Phase C	60,000	TBD	Approved	SAGD
<b>Narrows Lake</b>				
Cenovus says that overall progress at Phase A was 19 per cent complete at the end of the first quarter and site construction, engineering and procurement are progressing as expected.				
Phase A	45,000	2017	Approved	SAGD
Phase B	45,000	TBD	Approved	SAGD
Phase C	40,000	TBD	Approved	SAGD
<b>West Kirby</b>				
Cenovus says this project remains part of its portfolio of long-term development opportunities.				
Phase 1	30,000	TBD	Approved	SAGD
<b>Winfred Lake</b>				
Phase 1	30,000	TBD	Approved	SAGD
<b>CNOOC LIMITED</b>				
<b>Long Lake</b>				
Phase 1	72,000	2008	Approved	SAGD
Kinsella (K1A)	40,000	TBD	Approved	SAGD
Kinsella (K1B)	40,000	TBD	Approved	SAGD
<b>CONNACHER OIL AND GAS LIMITED</b>				
<b>Great Divide</b>				
Connacher says that Great Divide production for the first quarter averaged 11,400 barrels per day, an 16 per cent increase over the prior quarter. Drilling has been completed on six of nine planned infill wells; the remaining three will be drilled during the second quarter. These wells are expected to begin impacting production in the fourth quarter.				
Pod One	10,000	2007	Approved	SAGD
Alger	10,000	2010	Approved	SAGD
Expansion 1A	12,000	TBD	Approved	SAGD
Expansion 1B	12,000	TBD	Approved	SAGD
<b>CNOCCOPHILLIPS CANADA</b>				
<b>Summit</b>				
Cenovus/Phillips says over the next few years it plans to execute a disciplined capital program of approximately \$16 billion per year, generating three to five per cent compound annual production growth and margin growth from major development programs and projects already underway, including in the oil sands.				
Pilot	4,200	1997	Approved	SAGD
Phase 1	27,000	2007	Approved	SAGD
Phase 2	109,000	2015	Approved	SAGD
Phase 3 - Tranche 1	45,000	2020	Approved	SAGD
Phase 3 - Tranche 2	45,000	TBD	Approved	SAGD
Phase 3 - Tranche 3	45,000	TBD	Approved	SAGD
<b>DEVON CANADA CORPORATION</b>				
<b>Jackfish</b>				
Devon says that first-quarter results were highlighted by the excellent performance at Jackfish 1, where gross production exceeded nameplate facility capacity averaging 37,000 barrels per day. Construction of the company's Jackfish 3 project is nearly complete. Plant start-up at Jackfish 3 is expected in the third quarter of this year.				
Phase 1	35,000	2007	Approved	SAGD
Phase 2	35,000	2011	Approved	SAGD
Phase 3	35,000	2014	Approved	SAGD
<b>Jackfish East</b>				
Expansion	20,000	2018	Approved	SAGD
<b>Pike</b>				
Devon says the Pike project continues to move through the regulatory process.				
1A	35,000	2016	Approved	SAGD
1B	35,000	2017	Approved	SAGD
1C	35,000	2018	Approved	SAGD
<b>GRIZZLY OIL SANDS ULC</b>				
<b>Algar Lake</b>				
Grizzly Oil Sands part owner Gulfport Energy Corporation says that all 10 well pairs are on full stream circulation and averaged approximately 275 barrels of bitumen production per day during April 2014. Grizzly continues to see the production ramp-up as expected during stream circulation and currently anticipates the first phase of this facility to reach its peak production potential of approximately 6,200 barrels of bitumen per day in the second quarter of 2015.				
Phase 1	5,500	2014	Approved	SAGD
Phase 2	5,500	TBD	Approved	SAGD
<b>May River</b>				
Grizzly corporate part owner Gulfport Energy says that in the fourth quarter of 2013, the company submitted an initial 12,000-barrel-per-day SAGD development application with the regulatory authorities covering the eastern portion of the May River lease.				
Phase 1	6,000	2016	Approved	SAGD
Phase 2	6,000	TBD	Approved	SAGD
<b>HARVEST OPERATIONS CORP.</b>				
<b>BlackGold</b>				
Harvest says that Phase 1 of the project is approximately 93 per cent complete as of March 31, 2014. Phase 1 completion, commissioning of the central processing facility and first stream are expected in 2014.				
Phase 1	10,000	2015	Approved	SAGD
Phase 2	20,000	TBD	Approved	SAGD

CURRENT PROJECT	CAPACITY	START-UP	REGULATORY STATUS	TECHNOLOGY
<b>HUSKY ENERGY INC.</b>				
<b>McMullen</b>				
Husky says it has completed a successful winter delineation program at the McMullen, Caribou and Cadotte North emerging oil sands properties. The winter program at McMullen consisted of the drilling of 40 stratigraphic wells, the acquisition of 25 square kilometres of 3-D seismic survey data and the completion of environmental field study work.				
Thermal Conduction Pilot	750	2012	Approved	ASU
<b>JAPAN CANADA OIL SANDS LIMITED</b>				
<b>Hangingstone</b>				
Expansion	20,000	2016	Approved	SAGD
<b>Hangingstone Pilot</b>				
Pilot	11,000	1999	Approved	SAGD
<b>KOCH EXPLORATION CANADA CORPORATION</b>				
<b>Muskwa</b>				
Pilot	10,000	2015	Approved	SAGD
<b>LARICA ENERGY LTD.</b>				
<b>Germain</b>				
Larica says that steady operations have been achieved at Germain and production has begun to ramp up. The plant was running well throughout the first quarter, exceeding operational uptime targets, and continues to go up into the second quarter. A planned turnaround is scheduled for time for general maintenance. The company has also received the environmental completeness report on the regulatory application for the Germain expansion.				
Phase 1 CDP	5,000	2013	Approved	SAGD
Phase 2	30,000	2018	Approved	SAGD
Phase 3	60,000	TBD	Approved	SAGD
Phase 4	60,000	TBD	Approved	SAGD
<b>Saleski</b>				
Larica says that three of four wells were in their respective production cycles of the cyclic-SAGD process during the third quarter, helping to achieve the highest production rates since the pilot began operations in 2011. The construction and start-up schedule for Phase 1 has been delayed while the company seeks additional financing.				
Experimental Pilot	1800	2011	Approved	Cyclic and SAGD
Phase 1	10,000	2016	Approved	Cyclic SAGD
Phase 2	30,000	2017	Approved	IN-SITU
Phase 3	60,000	2020	Approved	IN-SITU
Phase 4	60,000	2023	Approved	IN-SITU
Phase 5	60,000	2026	Approved	IN-SITU
Phase 6	60,000	TBD	Approved	IN-SITU
<b>MEG ENERGY CORP.</b>				
<b>Christina Lake</b>				
With the benefits of its PISER initiatives at its Phase 1 and 2 assets and the ramp-up of production from Phase 2B, MEG reached a production record of 58,643 barrels per day in the first quarter, an increase of 80 per cent over first-quarter 2013 volumes of 32,531 barrels per day. The company says it is well on track to reach 80,000 barrels per day by 2015.				
Phase 1 Pilot	3,000	2008	Approved	SAGD
Phase 2A	22,000	2009	Approved	SAGD
Phase 2B	35,000	2013	Approved	SAGD
Phase 3A	50,000	2016	Approved	SAGD
Phase 3B	50,000	2018	Approved	SAGD
Phase 3C	50,000	2020	Approved	SAGD
<b>Surmont</b>				
Phase 1	41,000	TBD	Approved	SAGD
Phase 2	41,000	TBD	Approved	SAGD
Phase 3	41,000	TBD	Approved	SAGD
<b>OSUM OIL SANDS CORP.</b>				
<b>Sepiko Kevik</b>				
Osum says it anticipates regulatory approval for Sepiko Kevik in 2014, requiring financing in 2015-16.				
Phase 1	30,000	2018	Approved	SAGD
Phase 2	30,000	2020	Approved	SAGD
<b>STATOIL CANADA LTD.</b>				
<b>Kai Kos Dehesa</b>				
Statoil and partner PTTEP have entered into a transaction where the KKD asset will be split between the two firms, which currently own 60 per cent and 40 per cent, respectively. Statoil will continue as operator and own 100 per cent owner of the Lepmer and Corner projects while PTTEP will own 100 per cent of the Thornbury, Hangingstone and South Lebmer areas. Statoil says it will incorporate 14 new technologies at its oil sands operations in the coming years to provide step-changing operations improvement.				
Lebmer Demonstration	10,000	2010	Approved	SAGD
Corner	40,000	2017	Approved	SAGD
Lebmer Commercial	10,000	TBD	Approved	SAGD
Lebmer Expansion	20,000	TBD	Approved	SAGD
Corner Expansion	40,000	TBD	Approved	SAGD
Hangingstone	20,000	TBD	Approved	SAGD
Lebmer Northwest	20,000	TBD	Approved	SAGD
Lebmer South	20,000	TBD	Approved	SAGD
Thornbury	40,000	TBD	Approved	SAGD
Thornbury Expansion	20,000	TBD	Approved	SAGD

CURRENT PROJECT	CAPACITY	START-UP	REGULATORY STATUS	TECHNOLOGY
<b>SUNCOR ENERGY INC.</b>				
<b>Chard</b>				
Phase 1	40,000	TBD	Approved	SAGD
<b>Meadow Creek</b>				
Phase 1	40,000	TBD	Approved	SAGD
Phase 2	40,000	TBD	Approved	SAGD
<b>SURMONT ENERGY LTD.</b>				
<b>Wildwood</b>				
Surmont says it expects to receive regulatory approval in mid 2014. The company is working to obtain appropriate joint venture or financing partners.				
Phase 1	12,000	2015	Approved	SAGD
<b>VALUE CREATION INC.</b>				
<b>Advanced TriStar</b>				
The Alberta Energy Regulator says it will defer decisions on applications for in situ oil sands projects in the new "shallow thermal area" of the Athabasca region until it has developed formal regulatory requirements. Advanced TriStar is one of five impacted projects.				
AT-1	15,000	2016	Approved	SAGD
AT-2	30,000	2018	Approved	SAGD
AT-3	30,000	2020	Approved	SAGD
<b>TriStar</b>				
Value Creation says it is funded for the TriStar project but has not yet decided on a construction timeline.				
Pilot	1,000	TBD	Approved	SAGD
<b>COLD LAKE REGION - IN SITU</b>				
<b>BAYTEX ENERGY CORP.</b>				
<b>Gemini</b>				
According to Alberta Energy Regulator data, first oil was achieved at the Gemini SAGD project in March 2014.				
Pilot	1,200	2014	Approved	SAGD
Commercial	5,000	2017	Approved	SAGD
<b>BIRCHWOOD RESOURCES INC.</b>				
<b>Sage</b>				
Birchwood has filed its regulatory application for the \$230-million Sage project. Proxik Systems of Airdrie, Alta., will execute modular surface facility construction.				
Pilot	5,000	2015	Approved	Low pressure SAGD
<b>CANADIAN NATURAL RESOURCES LIMITED</b>				
<b>Primrose &amp; Wolf Lake</b>				
Canadian Natural says the cleanup of all four sites impacted by a 2013 second-quarter bitumen release is complete and the causation review is nearing completion. The company's new-term steaming plan at Primrose has been modified as a result of the seepage, with steaming being temporarily reduced in certain areas.				
Wolf Lake	13,000	1995	Approved	SAGD
Primrose South	45,000	1995	Approved	SAGD
Primrose North	30,000	2006	Approved	SAGD
Primrose East	32,000	2008	Approved	SAGD
<b>DEVON CANADA CORPORATION</b>				
<b>Waleye</b>				
Devon says the Waleye project is currently on hold.				
Phase 1	9,000	2017	Approved	SAGD
<b>HUSKY ENERGY INC.</b>				
<b>Caribou</b>				
Demonstration	10,000	TBD	Approved	SAGD
<b>Tockar</b>				
Phase 1	30,000	2006	Approved	SAGD
<b>IMPERIAL OIL LIMITED</b>				
<b>Cold Lake</b>				
Imperial says that the Nabys expansion was 65 per cent complete at the end of the fourth quarter of 2013. Plant construction progressed somewhat slower than planned due to lower contractor productivity and harsh winter conditions. Target start-up, although under pressure, remains year end 2014.				
Phases 1-10	10,000	1985	Approved	CS
Phases 11-13	30,000	2002	Approved	CS
Phases 14-16	40,000	2014	Approved	CS
<b>OSUM OIL SANDS CORP.</b>				
<b>Talga</b>				
Osum says engineering work is underway and some long-lead items have been ordered. Project sanction is expected in 2013. Financing is required.				
Phase 1	21,000	2016	Approved	SAGD
Phase 2	22,000	2018	Approved	IN-SITU
<b>PENGROWTH ENERGY CORPORATION</b>				
<b>Lindbergh</b>				
Pengrowth says that all of the major equipment for Lindbergh Phase 1 arrived on site during the first quarter and two of the three well pads have been drilled. The two-well pad pilot continues to show exceptional results. Production averaged 1,750 barrels per day in the first quarter with an average steam to oil ratio of 2:1. Alberta has also issued the final terms of reference for the Lindbergh expansion project.				

CURRENT PROJECT	CAPACITY	START-UP	REGULATORY STATUS	TECHNOLOGY
<b>Lindbergh (continued)</b>				
Pilot	1,260	2012	Completed	CSO
Phase 1	11,240	2016	Completed	SAGD
Phase 2	17,500	2017	Completed	SAGD
Phase 3	20,000	2018	Completed	SAGD
<b>ROYAL DUTCH SHELL PLC</b>				
<b>Orion</b>				
Shell had previously put up for sale its Orion asset, but says it has not received any offers that reflect the value and has ended sale activities.				
Phase 1	10,000	2009	Completed	SAGD
Phase 2	10,000	TBD	Completed	SAGD
<b>PEACE RIVER REGION — IN SITU</b>				
<b>ANDORA ENERGY CORPORATION</b>				
<b>Sawn Lake</b>				
Andora Energy by owner Pan Orient Energy says that steam injection began in the first quarter.				
Demonstration	1,400	2014	Completed	SAGD
<b>BAYTEX ENERGY CORP.</b>				
<b>Cliffdale</b>				
Baytex says that its wells drilled in 2013 (Pilot 2) are currently producing as planned under primary conditions to create the initial voidage required for the cyclic steam stimulation process. Steam injection at Pilot 2 is expected to commence in mid-2014.				
Pilot	2,000	2013	Completed	CSO
<b>Harmon Valley</b>				
Pilot	TBD	2013	Completed	CSO
<b>MURPHY OIL COMPANY LTD.</b>				
<b>Cadotte</b>				
Pilot	TBD	TBD	Completed	SAGD
<b>Sas/Cadotte</b>				
Murphy says the two-well pilot is showing promise, with the second well showing the best response. Production is early 2014 had reached as high as 670 barrels per day with a steam to oil ratio of 1:6.1.				
Pilot	TBD	TBD	Completed	CSO
<b>NORTHHERN ALBERTA OIL LTD.</b>				
<b>Sawn Lake</b>				
Company owner Deep Well Oil & Gas announced in late May that first steam had been achieved. Once steam commences flow is established between the two wells, then the oil pumping will commence. Oil production is anticipated after three months of steam injection.				
Pilot	700	TBD	Completed	Horizontal CSO
<b>PENN WEST PETROLEUM LTD.</b>				
<b>Harmon Valley South</b>				
Penn West has announced that in 2014 it will divest its oil sands assets in the Peace River region of Alberta as part of a strategy to prioritize light oil development. These assets comprise the Peace River Oil Partnership, which was established in 2010 with an affiliate of China Investment Corporation.				
Pilot	TBD	TBD	Completed	Horizontal CSO
<b>Sas Main</b>				
Penn West has announced that in 2014 it will divest its oil sands assets in the Peace River region as part of a strategy to prioritize light oil development.				
Pilot	75	2011	Completed	Horizontal CSO
Commercial	10,000	2015	Completed	Horizontal CSO
<b>PETROBANK ENERGY AND RESOURCES LTD.</b>				
<b>Dawson</b>				
Petrobank says it commenced CSS steaming operations at one of the two horizontal THAI production wells in late December 2013 and initiated steaming operations at the second well in mid-February 2014. First production is expected in the second quarter. The company is planning a nine-month production cycle followed by a second steam and production cycle. With success of these two CSS wells, Petrobank intends to prepare and submit an application for full field CSS development. Petrobank will merge with Touchstone Exploration Inc. and continue to operate under the latter's corporate name.				
Experimental THAI Demonstration	TBD	2014	Completed	THAI
Phase 2	10,000	TBD	Completed	THAI
<b>ROYAL DUTCH SHELL PLC</b>				
<b>Peace River</b>				
Cadotte Lake	175,000	1984	Completed	CSO
Cannon Creek - Phase 1	40,000	2017	Completed	SAGD
Cannon Creek - Phase 2	40,000	2018	Completed	SAGD
<b>SOUTHERN PACIFIC RESOURCE CORP.</b>				
<b>Red Earth</b>				
Southern Pacific says the cyclic steam simulation pilot at Red Earth is currently shut in.				
Pilot Expansion	3,000	TBD	Completed	CSO
Commercial	10,000	TBD	Completed	CSO
<b>NORTH ATHABASCA REGION — UPGRADER</b>				
<b>BP PLC</b>				

CURRENT PROJECT	CAPACITY	START-UP	REGULATORY STATUS	TECHNOLOGY
<b>Terra de Gincos</b>				
EP says that ongoing appraisal activities continue.				
Pilot	8,400	TBD	Completed	CSO
<b>CANADIAN NATURAL RESOURCES LIMITED</b>				
<b>Horizon</b>				
During the first quarter of 2014 Horizon continued to achieve strong and relative operating performance, with SCO production averaging approximately 113,000 barrels per day, a four per cent increase from 2013 first quarter levels and a one per cent increase over 2013 fourth-quarter levels. Production is targeted to increase in 2014 by about 11,000 barrels per day from 2013 levels as a result of the continued focus on effective and efficient operations. The overall Horizon Phase 2/3 expansion is 33 per cent physically complete.				
Phase 1	110,000	2009	Completed	CSO
Reliability - Tranche 2	5,000	2014	Completed	CSO
Phase 2A	10,000	2015	Completed	CSO
Phase 2B	45,000	2016	Completed	CSO
Phase 3	40,000	2017	Completed	CSO
<b>IVANHOE ENERGY INC.</b>				
<b>Tamarack</b>				
Ivanhoe Energy says that it has suspended activity on the Tamarack project based on the uncertainty that there is no timeline delayed by the Alberta Energy Regulator for a new regulatory framework for shallow SAGD projects, and that there is no clarity as to a path for approval for its Tamarack application. Until there is greater regulatory certainty as to a path to approval, Ivanhoe will limit Tamarack spending to only essential items.				
Phase 1	34,764	2017	Completed	CSO
<b>SUNCOR ENERGY INC.</b>				
<b>Base Operations</b>				
Suncor says that it reached a synthetic crude production record of 112,200 barrels per day in the first quarter of 2014, which included a 21 per cent increase in sweet production compared to the prior year quarter due to improved upgrader reliability.				
U1 and U2	225,000	1967	Completed	CSO
Millennium Vacuum Unit	35,000	2005	Completed	CSO
Millennium Coker Unit	97,000	2008	Completed	CSO
<b>SYNCRUDE CANADA LTD.</b>				
<b>Midland Lake/Aurora</b>				
Canadian Oil Sands Limited says that the cost estimate for the Midland Lake mine town replacement project has been reduced to \$3.6 billion from \$4.2 billion and the project remains on schedule for completion in the fourth quarter of this year.				
Base Plant Stage 1 & 2 Debitolbeck	250,000	1978	Completed	CSO
Stage 3 Expansion RUE-13	100,000	2006	Completed	CSO
Stage 3 Debitolbeck	75,000	TBD	Completed	CSO
<b>SOUTH ATHABASCA REGION — UPGRADER</b>				
<b>CNOOC LIMITED</b>				
<b>Long Lake</b>				
Phase 1	58,500	2009	Completed	CSO
<b>VALUE CREATION INC.</b>				
<b>Advanced TriStar</b>				
The Alberta Energy Regulator says it will defer decisions on applications for in situ oil sands projects in the new "shallow thermal area" of the Athabasca region until it has developed formal regulatory requirements. Advanced TriStar is one of five impacted projects.				
ATS-1	12,750	2016	Completed	CSO
ATS-2	25,500	2016	Completed	CSO
ATS-3	25,500	2020	Completed	CSO
<b>TriStar</b>				
Value Creation says it is funded for the TriStar project but has not yet decided on a construction timeline.				
Raw	820	TBD	Completed	CSO
<b>INDUSTRIAL HEARTLAND REGION — UPGRADER</b>				
<b>NORTHWEST UPGRADING INC.</b>				
<b>Redwater Upgrader</b>				
North West says construction activities continue, with approximately 500 personnel currently engaged at the site. Contracts are now in place for all major process units. A list of EPC contractors is available here: <a href="http://www.nwui.com">http://www.nwui.com</a>				
Phase 1	50,000	2017	Completed	CSO
Phase 2	50,000	TBD	Completed	CSO
Phase 3	50,000	TBD	Completed	CSO
<b>SHELL ALBION SANDS</b>				
<b>Scotford Upgrader 1</b>				
Minority partner Marathon Oil Corporation says its income from the project increased in the first quarter of 2014 primarily as a result of lower contract services and contract labour, and higher turnaround costs in the same quarter of 2013. The impact of higher price realizations in the first quarter of 2014 was mostly offset by lower net sales volumes due to reliability issues at both the Jackpine and Muskeg River mines.				
Commercial	155,000	2008	Completed	CSO
Expansion	100,000	2011	Completed	CSO
<b>VALUE CREATION INC.</b>				
<b>Heartland</b>				
Reports are that Value Creation could be up and running within 18 months of project sanction, but funding remains unclear.				
Phase 1	46,300	TBD	Completed	CSO
Phase 2	46,300	TBD	Completed	CSO
Phase 3	46,300	TBD	Completed	CSO



# GLOSSARY of oil sands terms

## Asphaltenes

The heaviest and most concentrated aromatic hydrocarbon fractions of bitumen.

## Barrel

The traditional measurement for crude oil volumes. One barrel equals 42 U.S. gallons (159 litres). There are 6.29 barrels in one cubic metre of oil.

## Bitumen

Naturally occurring, viscous mixture of hydrocarbons that contains high levels of sulphur and nitrogen compounds. In its natural state, it is not recoverable at a commercial rate through a well because it is too thick to flow. Bitumen typically makes up about 10 per cent by weight of oil sand, but saturation varies.

## Cogeneration

The simultaneous production of electricity and steam, which is part of the operations of many oil sands projects.

## Coking

An upgrading/refining process used to convert the heaviest fraction of bitumen into lighter hydrocarbons by rejecting carbon as coke. Coking can be either delayed coking (semi-batch) or fluid coking (continuous).

## Condensate

Mixture of extremely light hydrocarbons recoverable from gas reservoirs. Condensate is also referred to as a natural gas liquid, and is used as a diluent to reduce bitumen viscosity for pipeline transportation.

## Conventional crude oil

Mixture of mainly pentane and heavier hydrocarbons recoverable at a well from an underground reservoir, and liquid at atmospheric pressure and temperature. Unlike bitumen, it flows through a well without stimulation and through a pipeline without processing or dilution.

## Cracking

An upgrading/refining process for converting large, heavy molecules into smaller ones. Cracking processes include fluid cracking and hydrocracking.

## Cyclic steam stimulation (CSS)

An in-situ production method incorporating cycles of steam injection, steam soaking and oil production. The steam reduces the viscosity of the bitumen and allows it to flow to the production well.

## Density

The heaviness of crude oil, indicating the proportion of large, carbon-rich molecules, generally measured in kilograms per cubic metre (kg/m<sup>3</sup>) or degrees on the American Petroleum Institute (API) gravity scale; in western Canada, oil up to 900 kg/m<sup>3</sup> is considered light to medium crude—oil above this density is deemed as heavy oil or bitumen.

## Dilbit

Bitumen that has been reduced in viscosity through addition of a diluent such as condensate or naphtha.

## Diluent

A light hydrocarbon blended with bitumen to enable pipeline transport. See *Condensate*.

## Extraction

A process, unique to the oil sands industry, that separates the bitumen from the oil sand using hot water, steam and caustic soda.

## Froth treatment

The means to recover bitumen from the mixture of water, bitumen and solids ("froth") produced in hot-water extraction (in mining-based recovery).

## Gasification

A process to partially oxidize any hydrocarbon, typically heavy residues, to a mixture of hydrogen and carbon monoxide. Can be used to produce hydrogen and various energy by-products.

## Groundwater

Water accumulations below the Earth's surface that supply fresh water to wells and springs.

## Heavy crude oil

Oil with a gravity below 22 degrees API. Heavy crudes must be blended or mixed with condensate to be shipped by pipeline.

## Hydrocracking

Refining process for reducing heavy hydrocarbons into lighter fractions, using hydrogen and a catalyst, can also be used in upgrading bitumen.

## Hydrotransport

A slurry process that transports water and oil sand through a pipeline to primary separation vessels located in an extraction plant.

## Hydrotreater

An upgrading/refining process unit that reduces sulphur and nitrogen levels in crude oil fractions by catalytic addition of hydrogen.

## In situ

A Latin phrase meaning "in its original place." In situ recovery refers to various drilling-based methods used to recover deeply buried bitumen deposits.

## In situ combustion

An enhanced oil recovery method that works by generating combustion gases (primarily CO and CO<sub>2</sub>) downhole, which then "push" the oil towards the recovery well.

## Lease

A legal document from the province of Alberta giving an operator the right to extract bitumen from the oil sand existing within the specified lease area. The land must be reclaimed and returned to the Crown at the end of operations.

## Light crude oil

Liquid petroleum with a gravity of 28 degrees API or higher. A high-quality light crude oil might have a gravity of about 40 degrees API. Upgraded crude oils from the oil sands run around 30-33 degrees API (compared to 32-34 for Light Arab and 37-40 for West Texas Intermediate).

## Mature fine tailings

A gel-like material resulting from the processing of clay fines contained within the oil sands.

## Oil sands

Bitumen-soaked sand deposits located in three geographic regions of Alberta: Athabasca, Cold Lake and Peace River. The Athabasca deposit is the largest, encompassing more than 42,340 square kilometres. Total in-place deposits of bitumen in Alberta are estimated at 1.7 trillion to 2.5 trillion barrels.

## Overburden

A layer of sand, gravel and shale between the surface and the underlying oil sand in the mineable oil sands region that must be removed before oil sands can be mined.

## Permeability

The capacity of a substance (such as rock) to transmit a fluid, such as crude oil, natural gas or water. The degree of permeability depends on the number, size and shape of the pores and/or fractures in the rock and their interconnections. It is measured by the time it takes a fluid of standard viscosity to move a given distance. The unit of permeability is the Darcy.

## Petroleum coke

Solid, black hydrocarbon that is left as a residue after the more valuable hydrocarbons have been removed from the bitumen by heating the bitumen to high temperatures.

## Primary production

An in-situ recovery method that uses natural reservoir energy (such as gas drive, water drive and gravity drainage) to displace hydrocarbons from the reservoir into the wellbore and up to the surface. Primary production uses an artificial lift system in order to reduce the bottomhole pressure or increase the differential pressure to sustain hydrocarbon recovery, since reservoir pressure decreases with production.

## Reclamation

Returning disturbed land to a stable, biologically productive state. Reclaimed property is returned to the province of Alberta at the end of operations.

## Steam assisted gravity drainage (SAGD)

An in-situ production process using two closely spaced horizontal wells, one for steam injection and the other for production of the bitumen/water emulsion.

## Surface mining

Operations to recover oil sands by open-pit mining using trucks and shovels. Less than 20 per cent of Alberta's oil sands resources are located close enough to the surface (within 75 metres) for mining to be economic.

## Synthetic crude oil

A manufactured crude oil comprised of naphtha, distillate and gas oil-boiling range material. Can range from high-quality, light sweet bottomless crude to heavy, sour blends.

## Tailings

A combination of water, sand, silt and fine clay particles that is a by-product of removing the bitumen from the oil sand through the extraction process.

## Tailings settling basin

The primary purpose of the tailings settling basin is to serve as a process vessel, allowing time for tailings water to clarify and silt and clay particles to settle so that the water can be reused in extraction. The settling basin also acts as a thickener, preparing mature fine tails for final reclamation.

## Thermal recovery

Any in-situ process where heat energy (generally steam) is used to reduce the viscosity of bitumen to facilitate recovery.

## Upgrading

The process of converting heavy oil or bitumen into synthetic crude either through the removal of carbon (coking) or the addition of hydrogen (hydroconversion).

## Viscosity

The ability of a liquid to flow. The lower the viscosity, the more easily the liquid will flow.

## CONTACTS

### Oil Sands Producers

• Alberta Oilsands	<a href="http://www.aboilsands.ca">www.aboilsands.ca</a>
• Athabasca Oil Corporation	<a href="http://www.atha.com">www.atha.com</a>
• Baytex Energy	<a href="http://www.baytex.ab.ca">www.baytex.ab.ca</a>
• BlackPearl Resources	<a href="http://www.blackpearlresources.ca">www.blackpearlresources.ca</a>
• Brion Energy Corporation	<a href="http://www.brionenergy.com">www.brionenergy.com</a>
• Canadian Natural Resources	<a href="http://www.cnrl.com">www.cnrl.com</a>
• Cenovus Energy	<a href="http://www.cenovus.com">www.cenovus.com</a>
• Chevron Canada	<a href="http://www.chevron.ca">www.chevron.ca</a>
• CNOOC Limited	<a href="http://www.cnooc.com">www.cnooc.com</a>
• Connacher Oil and Gas	<a href="http://www.connacheroil.com">www.connacheroil.com</a>
• ConocoPhillips Canada	<a href="http://www.conocophillips.ca">www.conocophillips.ca</a>
• Devon Canada	<a href="http://www.dvn.com">www.dvn.com</a>
• Enerplus Resources Fund	<a href="http://www.enerplus.com">www.enerplus.com</a>
• E-T Energy	<a href="http://www.e-tenenergy.com">www.e-tenenergy.com</a>
• Grizzly Oil Sands	<a href="http://www.grizzlyoilsands.com">www.grizzlyoilsands.com</a>
• Harvest Operations Corp.	<a href="http://www.harvestenergy.ca">www.harvestenergy.ca</a>
• Husky Energy	<a href="http://www.huskyenergy.ca">www.huskyenergy.ca</a>
• Imperial Oil	<a href="http://www.imperialoil.ca">www.imperialoil.ca</a>
• Ivanhoe Energy	<a href="http://www.ivanhoeenergy.com">www.ivanhoeenergy.com</a>
• Japan Canada Oil Sands	<a href="http://www.jacos.com">www.jacos.com</a>
• Koch Exploration Canada	<a href="http://www.kochexploration.ca">www.kochexploration.ca</a>
• Korea National Oil Corporation	<a href="http://www.knec.co.kr">www.knec.co.kr</a>
• Laricina Energy	<a href="http://www.laricinaenergy.com">www.laricinaenergy.com</a>
• Marathon Oil	<a href="http://www.marathon.com">www.marathon.com</a>
• MEG Energy	<a href="http://www.megenergy.com">www.megenergy.com</a>
• Nexen	<a href="http://www.nexeninc.com">www.nexeninc.com</a>
• North West Upgrading	<a href="http://www.northwestupgrading.com">www.northwestupgrading.com</a>
• N-Solv	<a href="http://www.n-solv.com">www.n-solv.com</a>
• Oak Point Energy	<a href="http://www.oakpointenergy.ca">www.oakpointenergy.ca</a>
• Occidental Petroleum Corporation	<a href="http://www.oxy.com">www.oxy.com</a>
• Osum Oil Sands	<a href="http://www.osumcorp.com">www.osumcorp.com</a>
• Pan Orient Energy	<a href="http://www.panorient.ca">www.panorient.ca</a>
• Paramount Resources Ltd.	<a href="http://www.paramountres.com">www.paramountres.com</a>
• Pengrowth Energy Corporation	<a href="http://www.pengrowth.com">www.pengrowth.com</a>
• Petrobank Energy and Resources	<a href="http://www.petrobank.com">www.petrobank.com</a>
• PetroChina	<a href="http://www.petrochina.com.cn/ptc">www.petrochina.com.cn/ptc</a>
• PTT Exploration and Production	<a href="http://www.pttep.com">www.pttep.com</a>
• Shell Canada	<a href="http://www.shell.ca">www.shell.ca</a>
• Sinopec	<a href="http://www.sinopecgroup.com/group/en">www.sinopecgroup.com/group/en</a>
• Southern Pacific Resource Corp.	<a href="http://www.srpacific.com">www.srpacific.com</a>

• Statoil Canada	<a href="http://www.statoil.com">www.statoil.com</a>
• Suncor Energy	<a href="http://www.suncor.com">www.suncor.com</a>
• Sunshine Oilsands	<a href="http://www.sunshineoilsands.com">www.sunshineoilsands.com</a>
• Syncrude	<a href="http://www.syncrude.ca">www.syncrude.ca</a>
• Talisman Energy	<a href="http://www.talisman-energy.com">www.talisman-energy.com</a>
• Teck Resources	<a href="http://www.teck.com">www.teck.com</a>
• Total E&P Canada	<a href="http://www.total-e-p-canada.com">www.total-e-p-canada.com</a>
• Value Creation Group	<a href="http://www.vcgtek.com">www.vcgtek.com</a>

### Associations/Organizations

• Alberta Chamber of Resources	<a href="http://www.anc-alberta.com">www.anc-alberta.com</a>
• Alberta Chambers of Commerce	<a href="http://www.abchamber.ca">www.abchamber.ca</a>
• Alberta Energy	<a href="http://www.energy.gov.ab.ca">www.energy.gov.ab.ca</a>
• Alberta Energy Regulator	<a href="http://www.aer.ca">www.aer.ca</a>
• Alberta Environment and Sustainable Resource Development	<a href="http://www.srd.alberta.ca">www.srd.alberta.ca</a>
• Alberta Innovates	<a href="http://www.albertainnovates.ca">www.albertainnovates.ca</a>
• Alberta Innovation and Advanced Education	<a href="http://www.aae.alberta.ca">www.aae.alberta.ca</a>
• Alberta's Industrial Heartland Association	<a href="http://www.industrialheartland.com">www.industrialheartland.com</a>
• Building Trades of Alberta	<a href="http://www.buildingtradesalberta.ca">www.buildingtradesalberta.ca</a>
• Canada's Oil Sands Innovation Alliance	<a href="http://www.cosia.ca">www.cosia.ca</a>
• Canadian Association of Geophysical Contractors	<a href="http://www.cagc.ca">www.cagc.ca</a>
• Canadian Association of Petroleum Producers	<a href="http://www.capp.ca">www.capp.ca</a>
• Canadian Heavy Oil Association	<a href="http://www.choa.ab.ca">www.choa.ab.ca</a>
• In Situ Oil Sands Alliance	<a href="http://www.ioss.ca">www.ioss.ca</a>
• Lakeland Industry & Community Association	<a href="http://www.liica.ca">www.liica.ca</a>
• Natural Resources Conservation Board	<a href="http://www.nrbc.ca">www.nrbc.ca</a>
• Oil Sands Community Alliance	<a href="http://www.oscaalberta.ca">www.oscaalberta.ca</a>
• Oil Sands Secretariat	<a href="http://www.energy.alberta.ca">www.energy.alberta.ca</a>
• Petroleum Technology Alliance Canada	<a href="http://www.ptac.org">www.ptac.org</a>

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